MAICH_BioControl_safe

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1. IS the BIOLOGICAL CONTROL EFFECTIVE??
2. IS the BIOLOGICAL CONTROL SAFE ??
3. WHAT ABOUT INVASION OF INSECTS??
4. HOW TO PRACTICE SAFE BIOLOGICAL CONTROL??

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2. IS the BIOLOGICAL CONTROL SAFE ??
3. WHAT ABOUT INVASION OF INSECTS??
4. HOW TO PRACTICE SAFE BIOLOGICAL CONTROL??

Safe Biological Control deals with

1. the issue of non-target effects (plants and other invertebrates)
2. priorities and regulations were different than the ones we have today.
3. Related species of a pest in a target area
4. Not having enough information…Big Problem
5. Natural Enemies Can Disperse
6. Direct and Indirect non-target effects
7. Predicting non-target effects
8. Post-release evaluations are needed

EXAMPLES

1. The cane toad was introduced to control the greyback cane beetle (*Dermolepida albohirtum*) and the French cane beetle
2. A fly was imported from Europe to New England to control the gypsy moth
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NON TARGET EFFECT

Safe Biological Control


Indonesia
Arafura Sea
Papua New Guinea
Torres Strait
Timor Sea
Darwin
Kakadu National Park
Coral Sea
Arnhem Land
Gulf of Carpentaria
Indian Ocean
Daintree Rainforest
Pacific Ocean
Cairns
Broome
Kimberley Plateau
Barkly Tableland
Great Barrier Reef
Northern Territory
Hitchinbrook Island
Townsville
Whitsunday Islands
Dampier
Australia
Macdonnell Ranges
Queensland
Rockhampton
Gibson Desert
Alice Springs
Athertion Tablelands
Harvey Bay
Carnarvon
Shark Bay
Ayers Rock
Fraser Island
Western Australia
Gold Coast
Simpson Desert
Toowoomba
Brisbane
Great Victoria Desert
Gold Coast
Geraldton
Laverton
South Australia
Byron Bay
Coffs Harbour
Nullarbor Plain
New South Wales
Maitland
Kalgoorlie-Boulder
Ceduna
Blue Mountains
Newcastle
Perth
Great Australian Bight
Botany Bay
Freemantle
Port Lincoln
Adelaide
Wagga Wagga
Sydney
Wollongong
Esperance
Spencer Gulf
Canberra
Albany
Kangeroo Island
Ballarat
Victoria
Australian Capital Territory
Mount Gambier
Melbourne
Tasman Sea
Southern Ocean
Tasmania
Hobart


GREYBACK CANE BEETLE

Safe Biological Control

- However, sometimes it is hard to find strict monophagous or oligophagous natural enemies.
- Thus, sometimes polyphagous organisms are introduced to control pests in problem areas.

- A very good example of non target effects is the one provided by the introduction of the cane toad, *Bufo marinus*, introduced in several countries. One of those countries was Australia.
- The cane toad was introduced into Australia in the 1920s and 1930s. The toad was introduced to control the greyback cane beetle (*Dermolepida albohirtum*) and the French cane beetle (*Lepidota frenchi*) that were feeding on sugar cane creating a pest problem.

Non-target effects

The problem with the introduction of the cane toad is that the toad

1. eats insects on the ground not in the sugar cane.
2. Killing the beetle's predators out,
3. competing natural enemies of other pests and
4. attacking native fauna.
5. The toad also loves to eat basically everything else.

Non-target effects

- This decision of importing the cane toad to Australia was taken when foreign biological introductions to control pests **were not that strict.**
- Today no vertebrates are release as natural enemies (except for fish).

Outcompete

Kills pest predators

Attacks native arthropods

Non-target effects

Non-target effects

- So the cane toad is a very good example of the problem of introducing generalist agents.

- The opposite of the cane toad!!!
- The use of *B. thuringensis* (Bt) is a good example of a control method that is favored mainly due to its high specificity.

- Thus, non-target effects with Bt are reduced while non-target effects of the cane toad were major.

QUESTION

1. Is the use of the cane toad a good example of the problem of introducing generalist agents.

   JUSTIFY your answer

2. Is the use of *B. thuringensis* (Bt) is a good example of a control method that is favored mainly due to its high specificity.

   JUSTIFY your answer

ANSWER

NO

1. eats insects on the ground not in the sugar cane.
2. Killing the beetle's predators out,
3. competing natural enemies of other pests and
4. attacking native fauna.
5. The toad also loves to eat basically everything else.

YES

mainly due to its high specificity.

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2nd example

1. the issue of non-target effects (plants and other invertebrates)

non-target

SILK moth beneficial

1. priorities and regulations were different than the ones we have today.

Non-target effects

- *Compsilura concinnata* (the fly in the slide) is an example of importing a generalist natural enemy **in a time** when priorities and regulations were different than the ones we have today.
- This fly was imported from Europe to New England to control the gypsy moth.

- The fly never really controlled gypsy moths.
- Instead, it reduced considerably the populations of silk and cecropia moths.
- This example also show how the high priority we place on **conservation** was not present in the 1900s (when the parasitic fly was released).
- The priority at that time was to control the pest at all cost.

Generalist agents could represent a problem

Fly natural enemy

gypsy moth

pest

SILK moth

beneficial

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- Related species of a pest in a target area can represent a problem.
- The flower head beetle (*Rhinocyllus conicus*) was used to control introduced thistles in the US.
- the beetle not only eats on the imported or invasive thistle but also fed on related native thistle species.

Again,

- this beetle was introduced into the US when environmental concerns where not considered an issue and
- therefore not much research was invested into studying the ecology and biology of the introduced natural enemies.

Related species at target area could be a problem

Invasive thistle

Native thistle

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- Not knowing much about an introduced natural enemy can pose a serious thread to the environment and the biodiversity of an ecosystem.

Lets look at an example.

- The giant African snail (*Achantina fulica*) was introduced to Tahiti as a source of food.
- The introduced snail rapidly became an agricultural pest. So people wanted to control it. They thought about bringing a natural enemy of the snail and they found one.
- The predatory land snail *Euglandina rosea.* This predatory snail is native to Florida and Central America and it was immediately introduced into the pacific island of Moorea (an island 12 miles from Tahiti) to control the giant African snail there.

It did not work. WHY????????

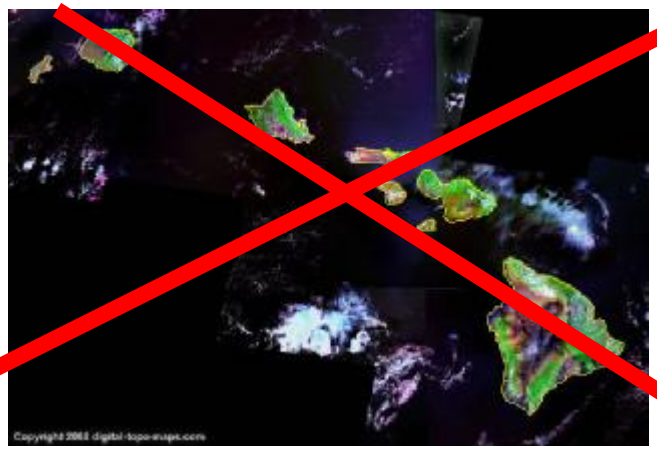
- **UNFORTUNATELY IT WAS LATE**

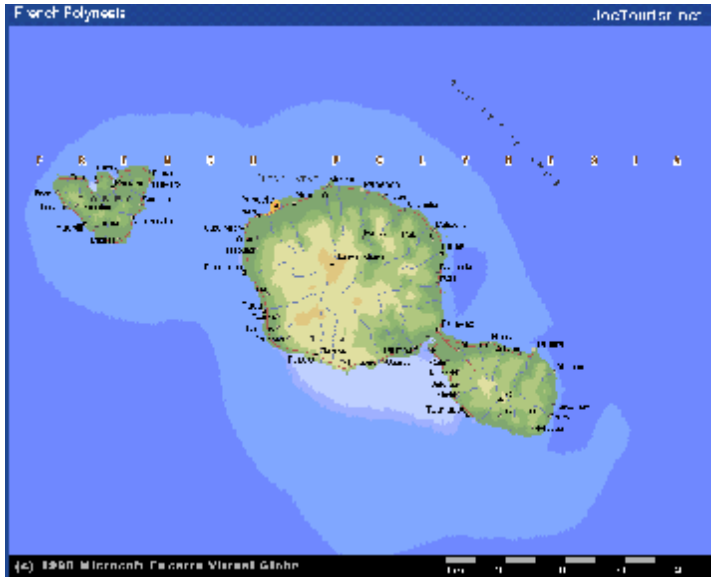
- When they were trying to figure out **WHY,** they learned that this same species of predatory snail **FAILED** to control snail pests in Hawaii and instead **ate a lot of native tree snails driving them to extinction**.

- Thus, in Hawaii the predatory snail was a complete failure.

- People THERE did not know about this and
- as a consequence of that lack of knowledge the introduced predator snail ate a lot of native snails species in Moorea.
- All due to not communicating had as a result a disastrous experience in Hawaii.
- This lack of information cost people of Moorea an important number of species being lost.

Not having enough information…Big Problem





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Knowing about the biology of a natural enemy not only involves

knowing what they eat

but also

how much can they move.

Natural Enemies Can Disperse

- In Australia *Opuntia* is a non native plant
- A caterpillar from Argentina was imported to Australia to control *Opuntia* (some kind of cactus).
- Because the caterpillar was successful in controlling *Opuntia* in Australia, this same caterpillar species was introduced later into the Caribbean to control *Opuntia* as well.

Natural Enemies Can Disperse

THE PROBLEM

- in the American continent we can find *Opuntia* species not only in the Caribbean region, but also in Mexico and Florida.
- The Argentinean caterpillars dispersed from the island of Puerto Rico to the American continent and became a problem there.
- in Puerto Rico (like in Australia) *Opuntia* is a weed.

,

In contrast, in Mexico and in Central America

Opuntia is highly regarded and it is used for food and appreciated for its cultural value to the region.

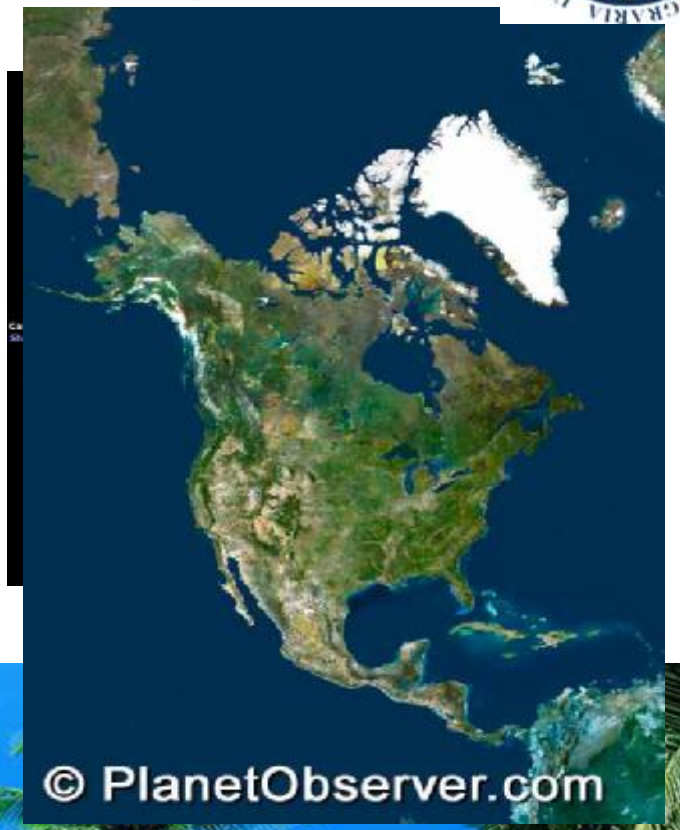
WHAT IS the Problem

NOT ESTIMATING (PREDICTING)

that the caterpillar could disperse to the continent

<u>was a big mistake.</u>

Natural Enemies Can Disperse



Opuntia Caribbean region, but also in Mexico and Florida.

Safe Biological Control

6. Direct and Indirect non-target effects

The direct non-target effects of natural enemy introductions have to do

with the introduced natural enemies

using non-target species as prey or hosts

The indirect non-target effects of introduced natural enemies

refer to

disturbances that the introduced natural enemies generate on some other organism

that

indirectly affect other non target species.

example,

competition between exotic and native natural enemies **constitutes an indirect effect** ,

because

- by affecting populations of a native natural enemy through competition
- introduced natural enemies that out compete native predators
- might let some native herbivore species numbers rise up to pests levels
- once the control exerted by their natural enemies have been relaxed.

Direct and Indirect non-target effects

Introduced

Native

Predicting non-target effects

How can we test for non-target effects?

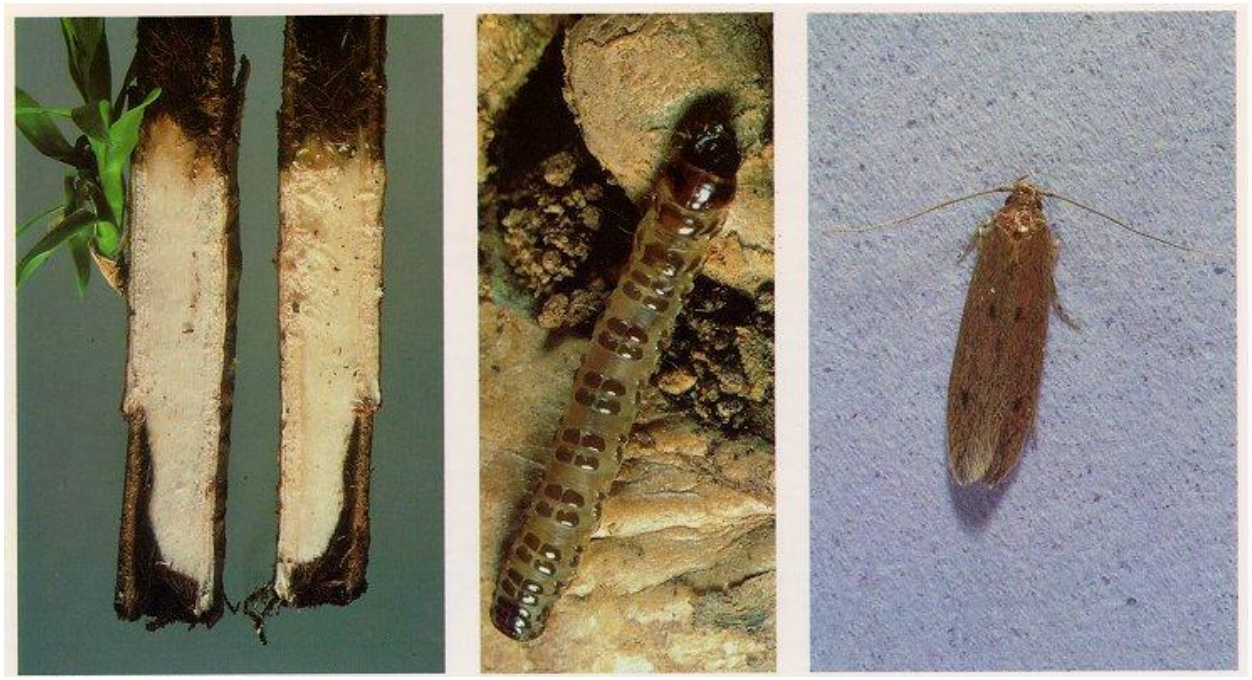
Predicting non-target effects

1. Measuring host-range
2. Other problems

Measuring host-range

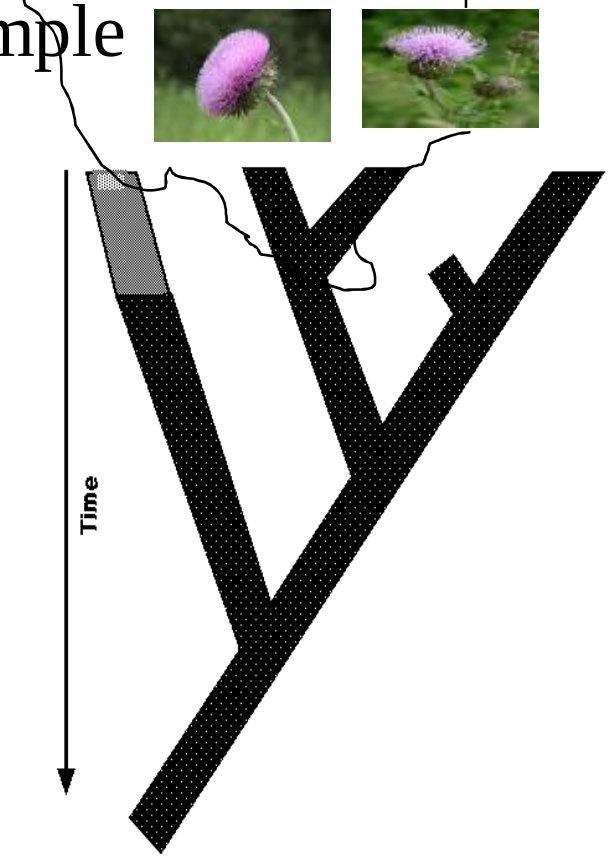
- We need to know what do introduced natural enemies like to eat before we bring them to a new area.
- It is important to know if insect preferences change as they age.
- Thus, measuring host preferences at all insect instars becomes important.

Measuring host-range



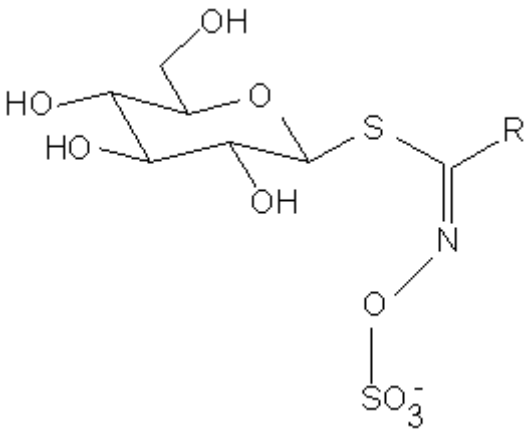
Measuring host-range

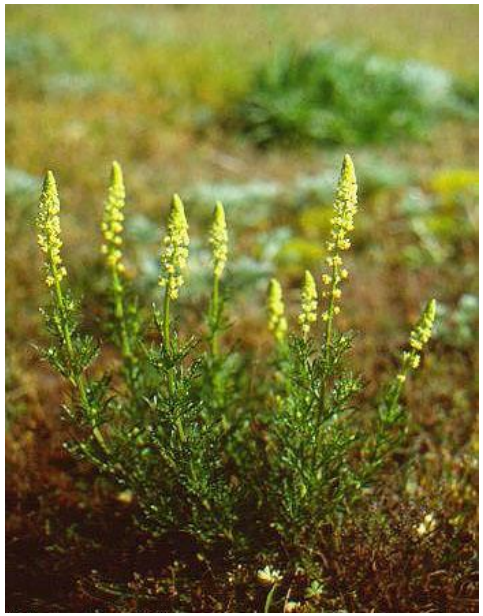
Natural enemies feeding or ovipositional preferecnes for species that are closely related taxonomically to the target pest should be tested. Remember what happened in the thistle example



Measuring host-range

Brassicaceae



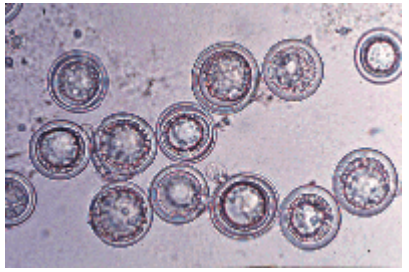


Rosedaceae

Measuring host-range

Sometimes natural enemies attack unrelated hosts in similar habitats. So sometimes host range has to do with looking for potential non-target hosts at the right places!

Measuring host-range



Other problems

- Competition
- Intraguild predation
- Hybridization

Post-release evaluations are needed